

ART: Automatic multi-step reasoning and tool-use for large language models

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Abstract

Large language models (LLMs) can perform complex reasoning in few- and zero-shot settings by generating intermediate chain of thought (CoT) reasoning steps. Further, each reasoning step can rely on external tools to support computation beyond the core LLM capabilities (e.g. search/running code). Prior work on CoT prompting and tool use typically requires hand-crafting task-specific demonstrations and carefully scripted interleaving of model generations with tool use. We introduce Automatic Reasoning and Tool-use (ART), a framework that uses frozen LLMs to automatically generate intermediate reasoning steps as a program. Given a new task to solve, ART selects demonstrations of multi-step reasoning and tool use from a task library. At test time, ART seamlessly pauses generation whenever external tools are called, and integrates their output before resuming generation. ART achieves a substantial improvement over few-shot prompting and automatic CoT on unseen tasks in the BigBench and MMLU benchmarks, and matches performance of hand-crafted CoT prompts on a majority of these tasks. ART is also extensible, and makes it easy for humans to improve performance by correcting errors in task-specific programs or incorporating new tools, which we demonstrate by drastically improving performance on select tasks with minimal human intervention.